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with the theory of Inference, under the heads of Imagination, Inference, Probable Reasoning and Induction. The chapters on Numerical Probability, Scientific Induction, The Interconnexion of General Truths, and Constructive Generalisation are of especial interest. Under the head of "Explanation" the author treats fully of the relation of cause and effect, which he describes as forming "one process or stream of existence passing before us." Classification has to do with general attributes and relations, as opposed to explanation, which is concerned with universal laws and their relations, and hence is the ideal of science.

The third part of this exhaustive work is concerned with the subjects of the Validity and Reality of Knowledge, and it deals with many important questions. Knowledge is declared to be valid as a system of judgments connected by valid methods, and the principle of validity itself is guaranteed by the system which it forms. In the chapter on External Reality the thing-in-itself receives attention, and the conclusion is arrived at that apprehension is of outer objects. The next chapter deals with Substance, and the subject is discussed under two heads, "that of the unity of various attributes in the thing, and that of the permanence of substance in the midst of qualitative changes." This leads to a consideration of the Conception of Self, which the author, distinguishing self from subject and from the ego, seems inclined to regard as the substantial whole to which consciousness belongs, although "the ultimate substance to which consciousness is referable remains doubtful." In his concluding chapters Mr. Hobhouse argues that Reality is an interconnected whole, probably organic, and he affirms that knowledge is relative only in the sense of being partial and inadequate, and that our conception of the whole grows constantly less inadequate. Careful consideration is given to the subject of variability, which is said to be "determined by the constructive necessities of the whole to which they belong." Finally, Logic is a hypothetical reconstruction of knowledge, and the function of Philosophy is declared to be the interpretation of reality by a synthesis of knowledge in which is included the "truth of feeling.'

C. S. W.

DIE ENTWICKELUNG DER GEHIRNBAHNEN IN DER TIERREIHE. *L. Edinger.* "Allgemeine Medicinische Central-Zeitung," 1896, No's 79 and 80.

In this recent address before the Sixty-Eighth Assembly of German Naturalists and Physicians Professor Edinger has so concentrated our present knowledge of nerve-evolution that it would be impossible to crystallise in a short review all that is contained in his admirable and suggestive lecture. We may, however, call attention to two or three points on which Dr. Edinger lays special emphasis.

Although dealing principally with the nervous mechanism of vertebrates, he rightly claims that the operations of these complex structures cannot be understood without studying lower organisms. And to this work he strongly insists that the investigator shall bring no prejudices; that he shall apply no anthropopsychic units of measurement; that he shall not describe the wriggling of a worm nor the closing of a clam's shell in the terminology of human psychology. This is emphasised by reference to Dr. Jacques Loeb's work on the sea-anemone, a pouch-like animal having at one end a mouth surrounded by tentacles. The animal possesses no definite nervous system. If one touches these tentacles with a piece of meat, they seize the morsel and press it into the mouth. If paper is offered, they do not take it. The tentacles seem, therefore, to exercise discrimination in the selection of food. As one observer puts it, "the actinia tastes." But Professor Loeb has shown in the clearest manner that no such interpretation is allowable. He was able by certain operations to cause the development of tentacles on parts of the body far from the mouth. These appendages could be of no possible use in the taking of food. Yet they exhibited the same selective power as those around the mouth. They took the meat and strove to push it through the body wall. They likewise rejected the paper. There was no indication that the animal understood the uselessness of the operation. The act of food-taking must, therefore, be attributed to chemical stimulation of the contractile tentacles. The animal no more tastes than does our stomach when peristaltic motions of its walls are aroused by the presence of food.

The savage declared that there must be a horse inside the locomotive. So we have put a man into every moth that seeks the light, every snail that withdraws into its shell, every worm that squirms and wriggles. It is "curious"! It "fears"! It "feels pain"!

The truth is we know almost nothing of the sensations of invertebrates. We do know that they lack wholly the apparatus which in the higher animals is associated with consciousness, and we are not justified in describing them in terms which imply the possession of mental powers or human sentiments.

Professor Edinger also cites the experiments which show that the crawling of an earthworm is a purely reflexive response to peripheral stimulation. Locomotion, although apparently adapted to the creature's welfare, is not an expression of consciousness. Dr. Edinger points out how well the experimental evidence of this fact, worked out by Friedlander and Loeb, is corroborated by the nervous structure of the earth-worm as described by G. Retzius.

The case of the worm is but one of many familiar instances illustrating how a sensory stimulus may, by proper apparatus and without conscious will, lead to an extensive series of complex co-ordinated motions. Edinger believes that this principle has wide application in the animal kingdom. In vertebrates it would explain those activities of which the spinal cord is the special centre. All the motions of the acraniate Amphioxus, the apparently purposeful reflexes of brainless frogs and the perfect swimming of brainless ducks are cases in point. That all of these are comparable with the crawling of the worm is proven not only by a comparative study of the phenomena themselves but also by the structure of the spinal cord, which, in so far at least as it is an independent centre, is but a complex variation of the principles of architecture found in the nervous system of worms. This may be taken as the first proposition demonstrated by the methods of comparative anatomy and comparative physiology.

His second theorem is that everything brainward of the spinal cord is a later development, and that the evolution of psychic functions is in direct proportion to the evolution of the cerebral cortex and its associative fibre-tracts. By a series of examples and a comparative study of each part of the brain, he shows how nearly this proposition is capable of demonstration at the present time. Concerning the medulla, cerebellum, midbrain. etc.—in fact all parts of the encephalon except the cortex and its association apparatus—the evidence adduced shows either a constant structure throughout the vertebrate phylum, as is the case with the midbrain, or else a development not regular nor proportioned to the height of an animal in the natural scale, but rather in accordance with its habits of life. An example of the latter condition is the olfactory apparatus, which is highly developed in the fishes, but is reduced to a minimum in the advanced group of birds.

In the cortex, however, we have an apparatus in comparison with which all other parts of the nervous system have undergone only minimal changes. From small beginnings, to be sought among the Selachians, have come the great hemispheres of the human cerebrum. Most important of all, the evolution of mental power has kept pace with the development of this part of the brain. While simple motions and the primary valuation of sensory impressions are accomplished throughout the vertebrate series by substantially the same apparatus, the higher associative faculties come only through the cerebral cortex. All the best evidence of physiology, histology, and pathology, points to this conclusion.

Tracing the evolution of the cerebrum Professor Edinger points out that, for the earliest cortex, connexion with the taste apparatus alone can with certainty be made out. "As the case stands now," he remarks, "we must consider the cortex as primarily a centre which with all its associations served the sense of taste." This first function can be traced throughout the vertebrate series, although somewhat doubtfully in birds. In the course of evolution other parts became connected with the cortex, and with each addition came enlargement of the psychic powers. This fact is illustrated by the cortical connexions of the optic nerve, which have been more thoroughly investigated than any other. In the fishes the optic fibres end in the roof of the thalamus. The same is true of the young of all animals including man.

"The baby new to earth and sky,
What time his tender palm is prest
Against the circle of the breast,
Has never thought that this is I."

He sees, but does not understand. He preserves no connexion of sight impressions. At the age of two months, however, at the very time when examination of the brain shows the development of the fibres connecting the midbrain with the cortex, the child begins to acquire sight experiences. He

"Finds 'I am not what I see,
And other than the things I touch.'"

The lower vertebrates never develop these cortical tracts, and just so surely their vision remains of a primary character. A hungry snake will crawl over a mouse without noticing it, provided the "tim'rous beastie" keeps still. It will swallow a dead mouse if the latter is kept in motion. But in the birds, where the primary optic centers first acquire connexions with the cortex, we find an entire change of mental power. Many experiments and observations show that the feathered world understands what it sees and associates therewith its earlier sight impressions.

It should not be overlooked that with the evolution of the cortex proper there is found a parallel increase of associative mechanism. As Professor Edinger states it, "Nothing characterises the mammalian brain more than the development of numerous and massive association tracts along with increase of the cortex." And here again mental evolution goes hand in hand with that of anatomical structure. Sense and substance, faculty and fabric, mind and matter are parallel and inseparable.

It will therefore be seen that the great authority of Professor Edinger is thrown with those who believe that differences in mental endowment imply differences in cerebral structure. In regard to what these differences are and in regard to the localisation of psychological functions in the cortex, he acknowledges the meagerness of present knowledge, admits the inadequacy of methods hitherto employed and shows clearly how the anatomical difference essential to a great quality of mind might exist in a given brain without its being perceptibly altered from the average in weight, shape, or convolutions. On this point he cites strong evidence and suggests interesting lines for investigation.

He further expresses the belief that the brain is a progressive development; that "no boundaries can be drawn between the mental possessions of the lowest and the highest vertebrates;" and finally that the evolution of the human brain and human intellect has not yet reached its maximum.

E. P. LYON.

KULTUR UND SCHULE. Präliminarien zu einem Schulfrieden im Anschluss an die Preussische Neuordnung von 1 April 1892. Von *Dr. Alex. Wernicke.* Osterwieck: A. W. Zickfeldt. 1896. Price, M. 2.40.

The pamphlet is a protest against the narrowness of those educators who would give all advantages to the gymnasial course and deprive the *Realschulen* even of the privileges which have reluctantly been conceded to them in Germany. The author is a man of serious convictions fighting for a noble cause. A discussion of his expositions would be out of place here, because whatever the school problems may be with which we are confronted in English-speaking countries, there is little danger of tyranny on the part of classical philologists.

ADAM SMITH'S PÄDAGOGISCHE THEORIEN IM RAHMEN SEINES SYSTEMS DER PRAKTISCHEN PHILOSOPHIE. Von *Dr. phil. Paul Bergemann.* Wiesbaden: Emil Behrend. 1896. Pages, 64. Price, M. 1.20.

Adam Smith's theories of political economy are well known while his views on the subject of education are neither remembered nor recognised. Dr. Bergemann therefore calls attention to Adam Smith's pedagogical propositions, which are treated in several chapters of his *Inquiry Into the Nature and Causes of the Wealth of Nations*, and sheds light upon their significance by setting them forth in their historical connexion and contrasting them with the views of other contemporary thinkers.

The editors of the *Vierteljahrsschrift für wissenschaftliche Philosophie* propose a prize of five hundred marks for the best solution of the following problem:

"Nachweis der metaphysisch-animistischen Elemente in dem Satz von der Erhaltung der Energie und Vorschlag zur Ausschaltung dieser Elemente."

The essay must be written in German, but competition is not limited to any nationality. Size should not exceed fifty or sixty pages of said magazine. Latest term, October 1. Address the editors of the *Vierteljahrsschrift*, Privatdozent Dr Fr. Carstanjen, Zürich V Englisch Viertel 49, or Dr. O. Krebs, Zürich V Minervastrasse 46.

Instead of the author's name each essay is to be superscribed by a motto. An accompanying envelope, also superscribed by the motto, is to contain the author's real name and address. The judges will be: Prof. Dr. Ernst Mach, of Vienna Prof. Dr. Alois Riehl, of Kiel, and the two editors of the *Vierteljahrsschrift*.

Mr. Thomas J. McCormack, the translator of Prof. Ernst Mach's *Mechanics* and *Scientific Lectures*, and of numerous other scientific works offering great difficulties to reproduction in English form, has been connected with The Open Court Publishing Co. since the foundation of *The Monist* and has rendered the editor much valuable assistance both in the reviewing of books and in the general supervision of the editorial work. Beginning with the April number he will be more closely associated with the staff of both *The Monist* and *The Open Court* in the capacity of assistant editor.